NOAA-M INSTRUMENTS

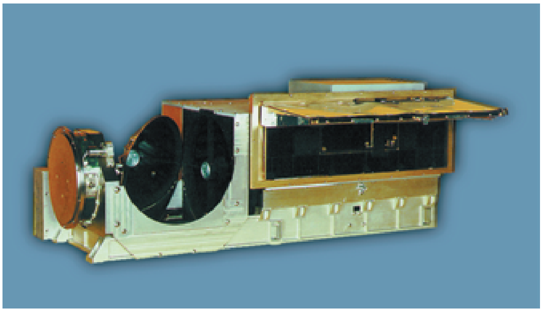
The NOAA-M primary instruments—HIRS, AVHRR, AMSU-A, and AMSU-B—have all been designed for a three-year mission. Detailed information for each primary instrument is found in Appendix A, as well as for the SBUV/2, which is designed for a two-year mission.

Further information is available on the web at http://poes.gsfc.nasa.gov, http://www2.ncdc.noaa.gov/docs/klm/index.htm, http://psbsgi1.nesdis.noaa.gov:8080/OSDPD/OSDPD2.html, and http://osdacces.nesdis.noaa. gov:8081/SATPROD. The NOAA-M spacecraft carries the following primary instruments (manufacturer is shown in italics).

ADVANCED VERY HIGH RESOLUTION RADIOMETER (AVHRR/3)

ITT A/CD

The AVHRR/3 is a six-channel imaging radiometer which detects energy in the visible and infrared (IR) portions of the electromagnetic spectrum. The instrument measures reflected solar (visible and near-IR) energy and radiated thermal energy from land, sea, clouds, and the intervening atmosphere. The instrument has an instantaneous field-of-view (IFOV) of 1.3 milliradians providing a nominal spatial resolution of 1.1 km (0.69 mi) at nadir. A continuously rotating elliptical scan mirror provides the cross-track scan, scanning the Earth from ± 55.4° from nadir. The mirror scans at six revolutions per second to provide continuous coverage.



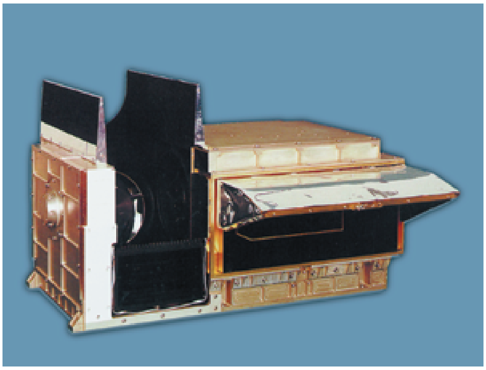
AVHRR/3

The AVHRR/3 provides spectral and gain improvements to the solar visible channels that provide low light energy detection. Channel 3A, at 1.6 microns, provides snow, ice, and cloud discrimination. Channel 3A will be time-shared with the 3.7-micron channel, designated 3B, to provide five channels of continuous data. An external sun shield and an internal baffle have been added to reduce sunlight impingement into the instrument's optical cavity and detectors.

HIGH RESOLUTION INFRARED RADIATION SOUNDER (HIRS/3)

ITT-A/CD

The HIRS/3 is an atmospheric sounding instrument with one visible channel, seven shortwave IR channels, and 12 longwave IR channels. The IFOV for each channel is approximately 1.4° in the visible and shortwave IR channels, and 1.3° in the longwave IR band which, from an altitude of 833 km (517.6 mi), provides a nominal spatial resolution at nadir of 20.3 km (12.6 mi) and 18.9 km (11.7 mi), respectively. The scan mirror provides a cross-track scan of 56 steps of 1.8° each. Each Earth scan takes 6.4 seconds and covers ±49.5° from nadir. IR calibration of the HIRS/3 is provided by views of space and the internal warm target, each viewed once per 38 Earth scans.



HIRS/3

The instrument measures scene radiance in the infrared spectrum. Data from the instrument is used, in conjunction with the Advanced Microwave Sounding Unit (AMSU) instruments, to calculate the atmosphere's vertical temperature profile from the Earth's surface to about 40 km (24.9 mi) altitude. The data is also used to determine ocean surface temperatures, total atmospheric ozone levels, precipitable water, cloud height and coverage, and surface radiance.

ADVANCED MICROWAVE SOUNDING UNIT-A (AMSU-A)

Aerojet

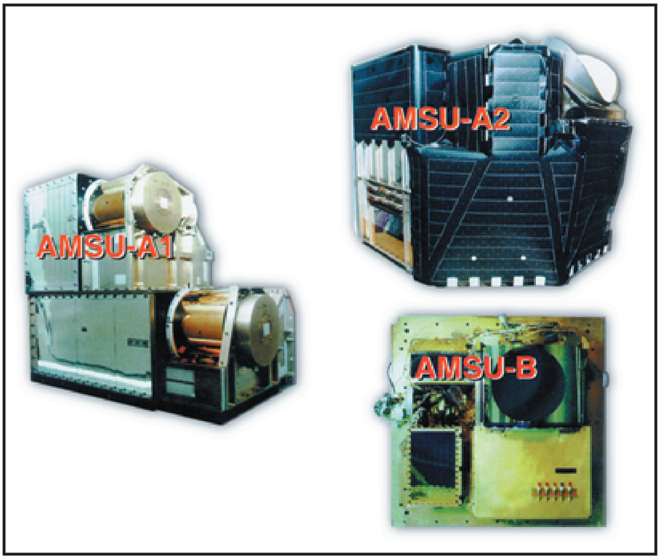
The AMSU-A measures scene radiance in the microwave spectrum. The data from this instrument is used in conjunction with the HIRS to calculate the global atmospheric temperature and humidity profiles from the Earth's surface to the upper stratosphere, approximately a 2-millibar pressure altitude (48 km or 29.8 mi). The data is used to provide precipitation and surface measurements including snow cover, sea ice concentration, and soil moisture.

The AMSU-A is a cross-track scanning total power radiometer. It is divided into two physically separate modules, each of which operates and interfaces with the spacecraft independently. Module A-1 contains 13 channels and Module A-2 contains two channels.

The instrument has an IFOV of 3.3° at the half-power points providing a nominal spatial resolution at nadir of 48 km (29.8 mi). The antenna provides a cross-track scan, scanning ± 48.3° from nadir with a total of 30 Earth fields-of-view per scan line. The instrument completes one scan every 8 seconds.

ADVANCED MICROWAVE SOUNDING UNIT-B (AMSU-B)

Astrium Limited via United Kingdom Meteorological Office

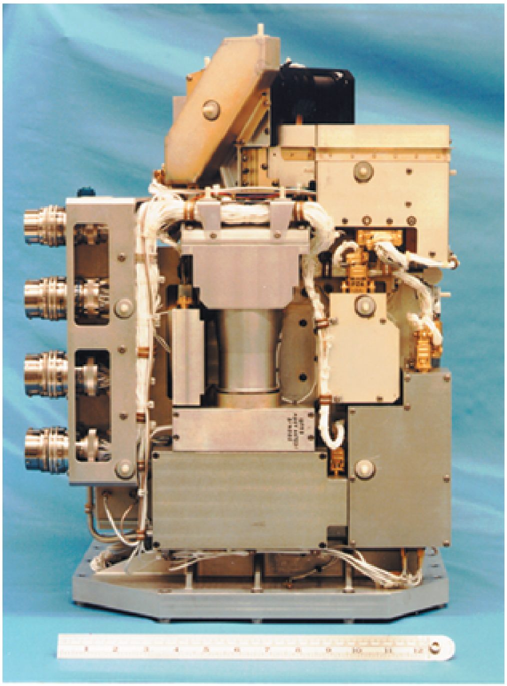


The AMSU-B is designed to allow the calculation of the vertical water vapor profiles from the Earth's surface to about a 200-millibar pressure altitude (12 km or 7.5 mi).

The AMSU-B is a cross-track, continuous line scanning, total power radiometer and provides measurements of scene radiance in five channels. The instrument has an IFOV of 1.1° (at the half-power points). Spatial resolution at nadir is nominally 16 km (9.94 mi). The antenna provides a cross-track scan, scanning ±48.95° from nadir with a total of 90 Earth fields-of-view per scan line. The instrument completes one scan every 2.66 seconds.

SOLAR BACKSCATTER ULTRAVIOLET RADIOMETER (SBUV/2)

Ball Aerospace



SBUV/2

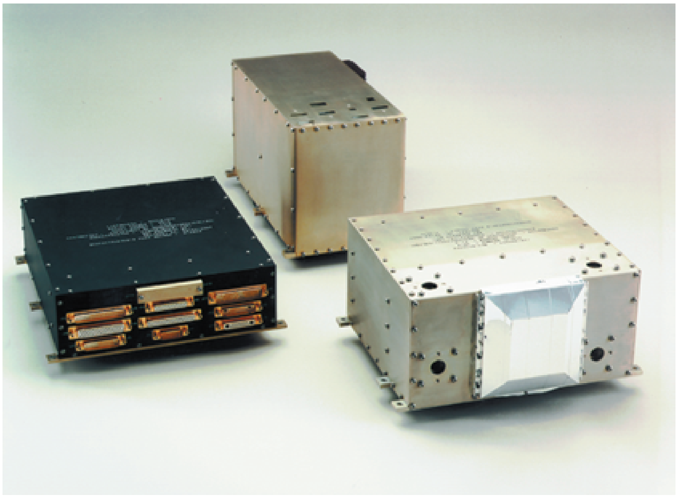
The SBUV/2 is a nadir-pointing non-spatial spectrally scanning ultraviolet radiometer carried in two modules. The two modules are the Sensor Module with the optical elements/detectors and the Electronics Module. The overall radiometric resolution is approximately 1 nanometer (nm). Two optical radiometers form the heart of the instrument: a monochrometer and a "Cloud Cover Radiometer" (CCR). The monochrometer measures the Earth radiance directly and selectively the Sun when a diffuser is deployed. The CCR measures the 379-nm wavelength and is co-aligned to the monochrometer. The output of the CCR represents the amount of cloud cover in a scene and is used to remove cloud effects in the monochrometer data.

The SBUV/2 measures solar irradiance and Earth radiance (backscattered solar energy) in the near ultraviolet spectrum (160 to 400 nm). The following atmospheric properties are measured from this data:

- The global ozone concentration in the stratosphere to an absolute accuracy of 1 percent
- The vertical distribution of atmospheric ozone to an absolute accuracy of 5 percent
- The long-term solar spectral irradiance from 160 to 400 nm
- Photochemical processes and the influence of "trace" constituents on the ozone layer.

SPACE ENVIRONMENT MONITOR (SEM-2)

Panametrics via NOAA Space Environment Center



Space Environment Monitor

The SEM/2 provides measurements to determine the intensity of the Earth's radiation belts and the flux of charged particles at the satellite altitude. It provides knowledge of solar terrestrial phenomena and also provides warnings of solar wind occurrences that may impair long-range communications, high-altitude operations, damage to satellite circuits and solar panels, or cause changes in drag and magnetic torque on satellites.

The SEM/2 consists of two separate sensor units and a common Data Processing Unit (DPU). The sensor units are the Total Energy Detector (TED) and the Medium Energy Proton and Electron Detector (MEPED).

The TED senses and quantifies the intensity in the sequentially selected energy bands. The particles of interest have energies ranging from 0.05 keV to 20 keV. The MEPED senses protons, electrons, and ions with energies from 30 keV to levels exceeding 6.9 MeV.

DATA COLLECTION SYSTEM (DCS/2)

CNES/France

Data collection platforms in the form of buoys, free-floating balloons, and remote weather stations transmit their data on a 401.65-MHz uplink to the spacecraft. The Data Collection System (DCS) measures environmental factors such as atmospheric temperature and pressure and the velocity and direction of the ocean and wind currents. The DCS collects and processes these measurements for on-board storage and subsequent transmission from the satellite.

For free-floating telemetry transmitters, the system determines the location within 5 km (3.1 mi) to 8 km (5.0 mi) and "float" velocity to an accuracy of 1 meter per second (mps).

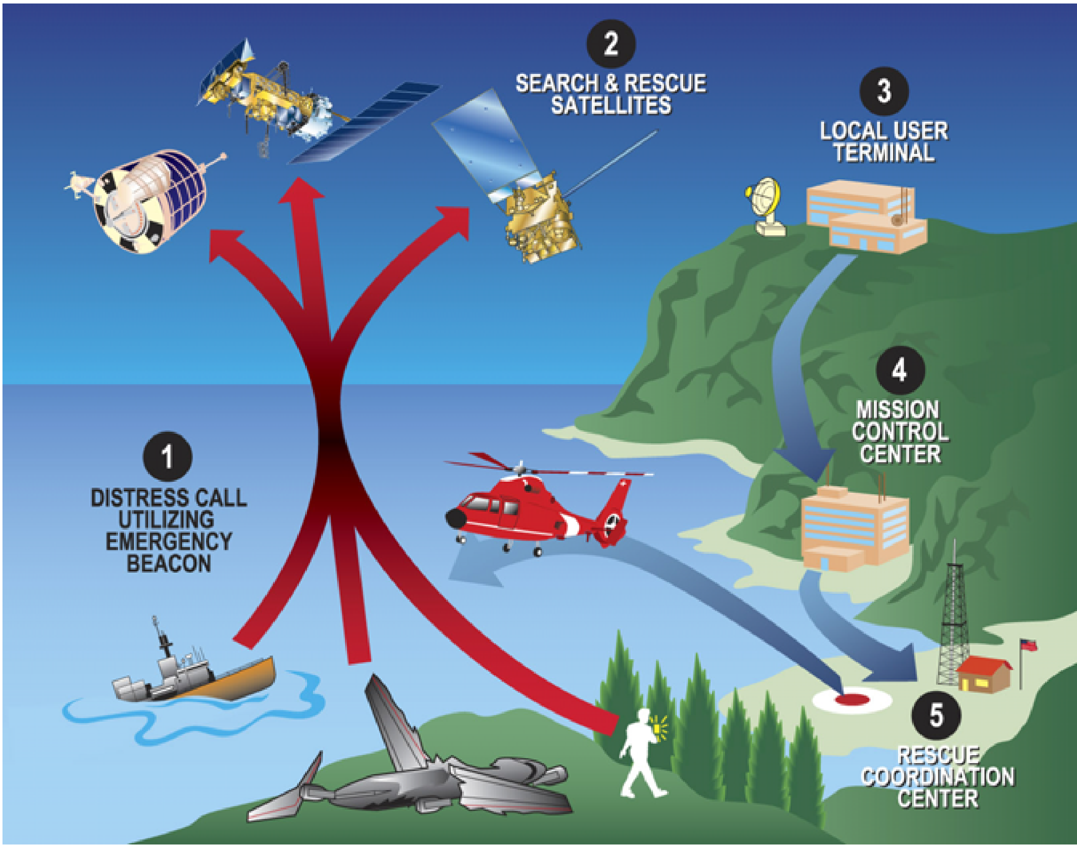
The stored data is transmitted to the ground once per orbit. Subsequently, the data is sent to the French Centre at the Centre National D' Etudes Spatiales (CNES) in Toulouse, France and the Service Argos Facility in Lanham, Maryland, for processing, distribution to users, and storage for archival purposes.

SEARCH AND RESCUE (SAR) INSTRUMENTS

Search and Rescue Repeater (SARR) DND/Canada
Search and Rescue Processor (SARP) CNES/France

The Search and Rescue instruments are part of the international COSPAS-SARSAT system designed to detect and locate Emergency Locator Transmitters (ELTs), Emergency Position-Indicating Radio Beacons (EPIRBs), and Personal Locator Beacons (PLBs) operating at 121.5, 243, and 406.05 MHz. The NOAA spacecraft carries two instruments to detect these emergency beacons: the Search and Rescue Repeater (SARR) provided by Canada and the Search and Rescue Processor (SARP-2) provided by France. Similar instruments are carried by the Russian COSPAS polar-orbiting satellites.

The SARR transponds the signals of 121.5, 243, and 406.05-MHz emergency beacons. However, these beacon signals are detected on the ground only when the satellite is in view of a ground station known as a Local User Terminal (LUT). The SARP detects the signal only from 406.05-MHz beacons but stores the information for subsequent downlink to a LUT. Thus, global detection of 406.05-MHz emergency beacons is provided.

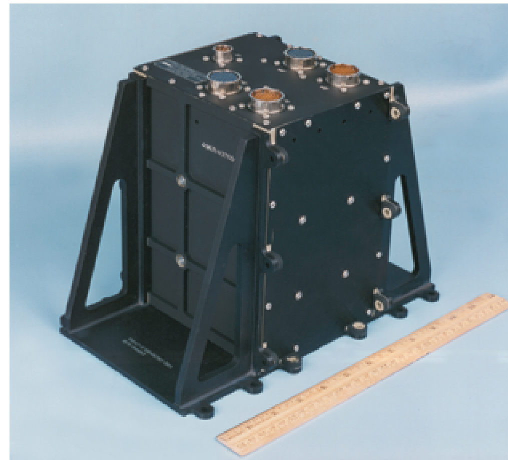


Search and Rescue Sequence of Events

After receipt of information from a satellite's SARP or SARR, a LUT locates the beacons by Doppler processing. The 121.5-MHz and 243-MHz beacons are located with an accuracy of approximately 20 km (12.4 mi), whereas the 406.05-MHz beacons are located with an accuracy of approximately 4 km (2.5 mi). The LUT forwards the located information to a corresponding Mission Control Center (MCC), which, after further processing, forwards the information to an appropriate Rescue Coordination Center that effects search and rescue.

The U.S. fishing fleet is required to carry 406.05-MHz emergency beacons. The 406.05-MHz beacons are also carried on most large international ships, some aircraft, and pleasure vessels, as well as on terrestrial carriers. The 121.5-MHz and 243-MHz beacons are required on many small aircraft with a smaller number carried on maritime vessels.

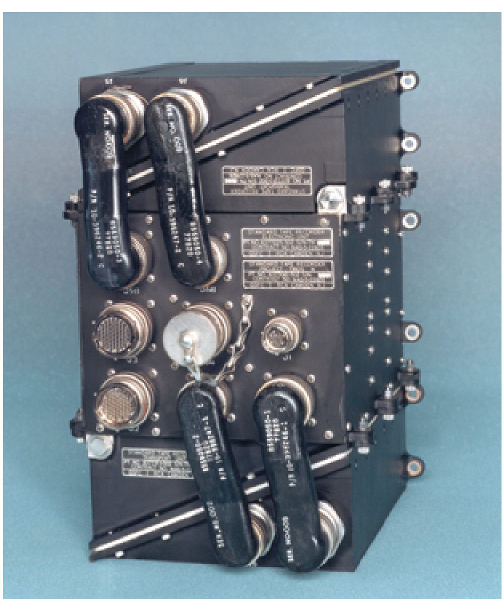
SOLID STATE RECORDER (SSR)
DIGITAL TAPE RECORDER (DTR)
L-3 Communications



Solid State Recorder

The Solid State Recorder and Digital Tape Recorders are complete recording/data storage systems that store selected sensor data during each orbit for subsequent playback. The recorders are part of the Command and Data Handling subsystem of the spacecraft that downloads to the Command and Data Acquisition Stations. A hybrid configuration of four DTRs and one SSR are on the NOAA-M spacecraft to provide multiple data streams, storage capacity, and hardware redundancy.

The DTR consists of an electronics unit containing the data conditioning circuitry, command and telemetry subsystems, power supply, timing references, and spacecraft interfaces. Two pressurized transport units each contain a coaxial reel-to-reel tape transport with associated gearless and motorless negator-spring tape tensioning system, bearing assemblies, motor/capstan, record/playback and erase heads, and record/playback electronics. Each DTR has a nominal storage capacity of 1 Gbit and selectable playback rates up to 2.66 Mbps.



Digital Tape Recorder

The SSR performs identical functions to the DTR using solid state Dynamic Random Access Memory (DRAM) devices instead of magnetic tape and its associated electromechanical elements. It provides an increased storage capacity of 2.8 Gbits and superior bit error rate performance with its custom Error Detection and Correction (EDAC) circuitry.